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# The American Biology Teacher

Vol. 8 NOVEMBER, 1945 No. 2

A Simple Demonstration of Metamorphosis - H. L. Irons 27

Inclusion of Ecology in the General Biology Course - - - - Julian D. Corrington 30

Student Choices of Outside Readings in Biology - - - - Victor A. Greulach 33

A Shoe-Box Herbarium - - - - - W. A. Anderson 34

Teaching Aids - - - - - - - - 35

Notes on Chicago Meeting - - - 36

Diseases and Infestations in Captive Snakes - Abbott Book 37

A Group Plan in Biology - - - - Sister Maria, I.H.M. 41

A Science Teachers' Monthly Round Table Plan - - - - - - - L. E. Hoffman 43

Books - - - - - - - - - - - - 47

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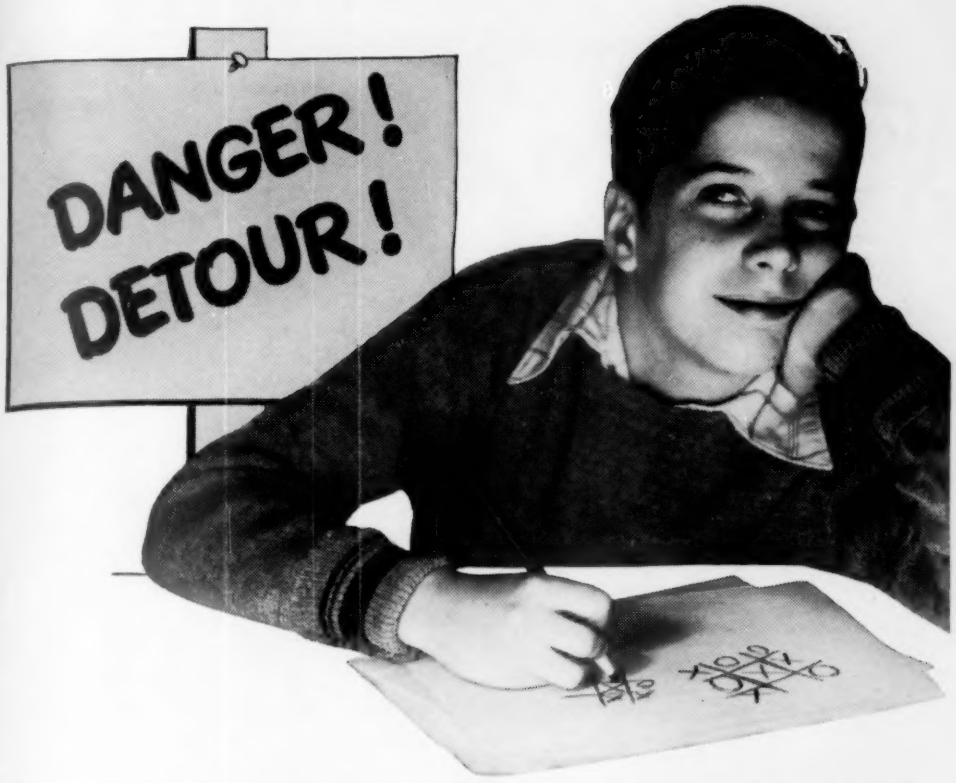


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## THE AMERICAN BIOLOGY TEACHER

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# The American Biology Teacher

Vol. 8 NOVEMBER, 1945 No. 2

## A Simple Demonstration of Metamorphosis

H. L. IRONS
Storer College, Harpers Ferry, West Virginia

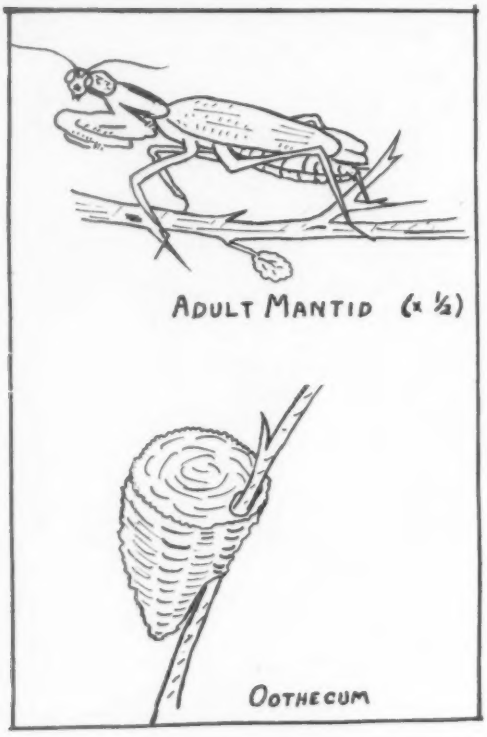
Metamorphosis is one of the most interesting biological phenomena. With over 625,000 known species of insects, nearly all undergoing some type of metamorphosis, it is one of the most common of the natural phenomena. Nevertheless, many students of biology, both high school and college, do not understand the meaning of the word metamorphosis, and are equally uninformed about the events and kinds of the process.

The following simple experiment in insect metamorphosis is designed to fill this gap in the students' knowledge. It is inexpensive and may be carried out with very little special apparatus or previous scientific training. It may be conducted as a class demonstration or as a special student project.

Metamorphosis means transformation or change in form. As applied to biology, metamorphosis refers to the successive developmental changes experienced by an organism as it grows from the initial embryonic form to the final adult form. Metamorphosis may be gradual* or complete. If the successive developmental changes result in forms which look much alike the metamorphosis is gradual. Gradual because the first free-living form is, in reality, a miniature adult. These miniature forms attain adulthood by a gradual increase in size accompanied by successive losses of the outer skin case.

Complete metamorphosis is accomplished by developmental transformations which give rise to successive forms bearing no resemblance to each other. The first free-living form is worm-like

* Entomologists recognize four types of metamorphosis, *ametabolous* (without metamorphosis), *paurometabolous* (gradual), *hemimetabolous* (incomplete), and *holometabolous* (complete metamorphosis). Examples for each are bird lice, grasshoppers, dragon flies, and butterflies respectively. Some biologists combine the paurometabolous and hemimetabolous types because they are so much alike. Nymphs of the former are land forms and those of the latter aquatic.




and is called a feeding larva. The adult form, mature imago, is a striking contrast to its larval ancestor. Between these two forms there is a transition form frequently called the pupa. In this transitional or pupa form, momentous changes involving the complete transformation of every worm-like organ, structure, and feature into its adult counterpart take place. Thus the organism which enters the pupa stage as a lowly worm may emerge as a pestiferous house-fly, an industrious honey bee, an exquisitely tinted butterfly, or as a tiny ferment-loving fruit fly (Drosophila).

In this experiment the praying mantis is used to demonstrate gradual metamorphosis, and the drosophila to demonstrate complete metamorphosis.

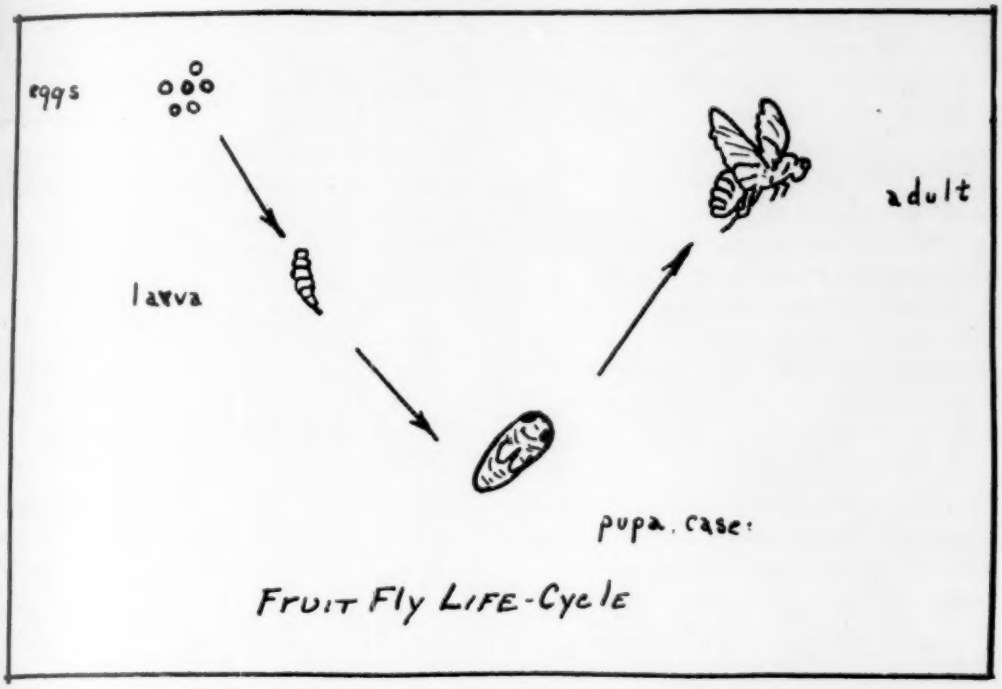
### Gradual

Egg cases of the praying mantis are available in the fall. In sections of the country frequented by the mantis the ootheca may be collected from the stems of low bushes and wild grasses after the leaves begin to drop. Each case contains several score of viable eggs. One case will give enough living mantes for a class of average size. In sections of the country where the mantis is rare the ootheca may be purchased from a biological supply house for a few cents each.

The cases are placed in a terrarium; or a common fruit jar will do just as well. If green plants are not available for furnishing moisture, line the bottom of the jar or terrarium with blotting paper. Daily dampening of the blotting paper will supply sufficient moisture for the normal development of the eggs. The use of blotting paper eliminates the hazard of drowning the young mantes as they hatch. A few dry twigs may be added to the jar to serve as perches. The top of the container is covered with a carefully fitted piece of cardboard. This will allow for an ample supply of fresh air in the container, reduce evaporation and rapid drying of the blotting paper, and serve to restrain the very active young mantes when they hatch.

The container should now be placed near a radiator or in a room where a warm constant temperature is maintained. If an incubator is used a temperature of 25° C. should be maintained. At this temperature the mantes will begin to appear in about eighteen days. For lower incubator temperatures or variable room temperatures several additional days may elapse.

The young mantes are fascinating little creatures. They are light tan to greyish in color when hatched. They are like the adult mantes in all respects save color and size. As soon as they hatch they are ready to eat and food must be supplied. Being carnivorous




they will soon begin preying upon each other in the absence of a suitable food supply.

Through a series of molts, made necessary by the body outgrowing the skin-case, the mantes attain adulthood.

### Complete

The second part of this interesting experiment involves the culturing of fruit flies. These busy little insects will clear up the mystery of complete metamorphosis for the student, and serve as a food source for the young carnivorous mantes.

A clean milk bottle is thoroughly rinsed with hot water and left upside down to drain. A paste is made by boiling a small quantity of corn meal and water together for about five minutes. Pour this mixture into the bottom of the milk bottle to a depth of one inch. Add to the mixture pieces of ripe fruit. Banana, pear, or grapes serve especially well. Citrus fruits should not be used. A four-inch strip of clean paper is inserted into the bottle so as to extend up the side for approximately three inches. Stopper the bottle and let the corn meal congeal.

After an hour place the bottle in a horizontal position and remove the stopper. In this position the bottle serves as a baited trap for attracting fruit flies. The trap should be observed from time to time and when several fruit flies have entered the bottle it is again stoppered with cotton.

Among the fruit flies attracted there should be one or more females. These will lay eggs in a day or two. The eggs appear as a fine white film on the surface of the corn-meal medium. In from five to seven days the bottle will come alive with tiny feeding larvae. They are the first free-living or larval forms of complete metamorphosis. They will worm their way through the corn-meal, feeding on the fermenting fruit juices. In four days the larvae will crawl up on the paper and sides of the bottle. Here they become quiescent and the larval

skin will become tough and brown. This case is the puparium and within it the marvelous transformations which will result in the emergence of the adult imago (fly) take place. In five days the feeble, wet-winged adults break out of their pupa cases. The exact time of emergence is determined by the incubation temperature and the species used.

These fruit flies are now ready for their second role as food for the young mantes. Introduce them into the container with the hungry mantes and they will do the rest.

As the mantes continue to feed on the flies they increase in size and undergo a series of moults, thus demonstrating incomplete or gradual metamorphosis.

In order that adult fruit flies will be available when the mantes hatch; the second part of the experiment should be started about a week or ten days after the ootheca have begun to incubate.

We hope that small schools with limited funds and little or no equipment may find this experiment useful as a teaching device. Students can furnish all of the apparatus and ingredients from their homes. Budding biologists will find the experiment and the insects used most intriguing.

When the mantes are no longer needed, release them in some near by wooded area where they may prey on insect pests.

# Inclusion of Ecology in the General Biology Course

JULIAN D. CORRINGTON
Univeristy of Miami, Coral Gables, Florida

The introductory college course in botany takes up elementary plant ecology as a matter of necessity, but the corresponding course in general biology or zoology commonly does not. This condition has probably arisen from the adoption of either of two extreme premises on the part of author and teacher; first, an over-simplification approach that regards elementary ecology as no more than grammar school natural history and hence unworthy of inclusion at the college level; secondly, an over-specialization approach, considering ecology too advanced and difficult for incorporation in a freshman subject. Neither view is correct.

Whether the teacher thinks about the matter or not, a great deal of ecology is perforce incorporated in any introductory biological course; hence it follows that it would be better to recognize this fact and call the subject by its proper name. Even the simple result of popularizing the word ecology would justify this procedure which, moreover, is the logical one. That long-suffering individual, the man-on-the-street, nearly always understands the terms ornithology, entomology, physiology, and genetics; many of his brothers apprehend embryology, anthropology, or endocrinology; but rare indeed is the person who has not been exposed to the term in a formal course who understands the word ecology. It is all Greek to him, and οἶκος does not have its equivalents or derivatives in the common language.

Because the detailed study of embryology involves material of some complexity, this is not considered sufficient reason to exclude a survey of main fea-

tures of frog development from beginning courses; likewise advanced ecology may incorporate some rather steep physics and chemistry, but this is not a valid excuse for denying freshmen all acquaintance with the subject.

To our mind, a full and separate course in ecology belongs properly in the graduate school. The ecologist needs a tremendously broad foundation: mathematics through calculus; physics; chemistry to include qualitative and quantitative analysis; geology as far as petrography and mineralogy, and with meteorology if possible; botany; general zoology, and several advanced zoological courses; entomology and physiology certainly, doubtless invertebrate and vertebrate zoology, and probably such biological specialties as appeal to individual aims and interests as ornithology, protozoology, bacteriology, forest botany, or plant pathology. Such a program, with accompanying requirements in other fields of the liberal arts, will consume a student's full time, from matriculation until he is ready for the doctorate. In this period he may or may not receive a formal course in ecology proper; indeed, if the preceding program were carried out, ecology as such scarcely seems necessary in that he will acquire the information in all of these other subjects and in his outside reading and, when through with them, is ready to undertake a problem in ecology. However, if a specific course is offered, it should come late in this agenda, after most of the rest of such a curriculum has been assimilated as groundwork, and will then consist of lectures that summarize and correlate his previous information and add the professional language and attitude of the ecologist, and of problems for laboratory and field.

The freshman course, on the other hand, is designed primarily for those who will take no further science. If any ecology at all is to be given this student, it is then or never. Our opinion is, even for a course in general zoology, that discussion of the subscience, ecology, should begin with the botanical background. Certainly the whole topic of nutrition in animals is meaningless unless the ultimate source of the potential energy in foods is revealed, and so it is essential to explain photosynthesis and the cycles in nature of carbon and nitrogen.

There will then follow such chapters as food chains, major environmental factors, intra- and interspecific relations, offensive and defensive adaptations, plant and animal communities and successions. Information of a practical nature on the necessity for and methods of obtaining conservation are very badly needed in most of our states, and this is the logical place at which to incorporate such material. In many respects the economic welfare of our future generations hinges upon public recognition of conservation problems; the matter becomes increasingly urgent each year and is now more so than ever since wartime practices required speed and waste, and postwar planning must include ways and means of regaining the lost ground.

A discussion of migration can lead imperceptibly into the neighboring field of zoogeography, while ecologic associations are seen as units of the larger life zones and faunal and floral regions. Space distribution is followed by vertical or time distribution, and this in turn is succeeded by the climax association for the biological sciences—a survey of organic evolution. In all of these discussions, no points of lasting value will be gained by cluttering the subject matter with the jargon of the professional ecologist. Terms such as consocies and subclimax are necessary as tools in advanced papers but have no place in general education. We would limit technical terminology to such broad concepts

as exemplified by classifying plants as hydrophytes, mesophytes, and xerophytes.

Among benefits of ecological information in the general course is the acquisition of a new point of view of nature. Surprisingly enough, even a simplified natural history approach provides many mature students with material for thought that strikes them as new and unfamiliar, yet deals with subject matter they realize is valuable and should be known to everyone. We had thought the ecological part of the course would prove far easier for the beginner than the anatomical and physiological work on the frog. But experience has forced the admission that the reverse is more often the case. Students have a certain general familiarity with the structural-functional chapter in zoology; perhaps they sense in advance that this section is going to involve a mass of difficult detail, and they prepare themselves accordingly, or use proper study habits. When the organismal point of view is sprung on the unsuspecting victims, they are commonly bewildered at first and find the going tough, even though a minimum of technicalities is included and the chief facts presented be those of common experience.

Our findings have been that this part of the course needs a carefully planned teaching program and a policy of making haste slowly. We have had students who made a *B* grade on the first monthly examination in anatomy who then received an *F* when tested in the apparently far easier ecological group of studies. There are exceptions, of course, but this state of affairs must be guarded against. The really superior students master the one field as well as the other, and find ecology stimulating and interesting.

A second benefit is the indirect one of finding that all science is one. No biological study breaks down the artificial boundaries between the separate sciences so completely and obviously as does ecology. A third benefit lies in the use of the field trip wherever possible. If the chemist and the physicist could, in a previous generation, point the finger of scorn at the natural scientist and exclaim, "Ah, but *your* subject is not an experimental science!"—today the tables are turned, as the geologists and biologists not only have their experimental methods, but can inquire of the physical scientists, "And where, pray, are your field trips?"

Field studies can be conducted in nearly every part of the country. The unthinking might jump to the conclusion that city institutions would be automatically disbarred from these delightful bucolic excursions, but as a matter of fact, the larger the city, the larger and more numerous are their parks, and since these parksites were selected with an eye to variety of natural scenery and are commonly centered about some body of water, the advantage often lies with the urban college or university.

The immediate environment matters far less than the staffing of the party and the planning of the results to be obtained. Success requires small groups, which means splitting the large class into many troops, and there will usually be few leaders of sufficient experience available. The average laboratory assistant is unsatisfactory; a person of much wider and more mature background is needed. We have overcome this difficulty by taking ten students out of the regular laboratory class and conducting them on a field trip while the remainder of the section performed the assigned indoor work under the guidance of the assistants, for which instruction they are entirely qualified. At the next period, weather permitting, a second group was taken on a similar trip, with

the same objectives, and so on until the whole class had covered the field work. Each student was absent from the laboratory one full period, consequently they all came out in the end with the same amount of both laboratory and field instruction. Likewise we have found it advisable, in coeducational institutions, to have each field party consist wholly of men one day and women the next, thereby minimizing the distractions. Field notes were required and a written report submitted by a specified date.

One such trip in each semester is as much as can be attempted by this method, and usually all that the year's schedule of laboratory assignments will permit in any case. Insects in the fall and birds in the spring make good subjects around which to center the studies. The students were also encouraged to make trips of their own, in small groups, as week-end recreation, and many would do so and report what they had seen, often with great enthusiasm. Organized field trips are an eye-opener and greatly enhance the pleasure of later personal rambles through the countryside. Trips, to museums, aquaria, and zoological parks also have their ecological aspects.

We believe that the total approach to the problem of the organism is equal in importance to the piecemeal view, and that one without the other tells only half the story. A man may inspect any number of parts of an automobile and become thoroughly familiar with carbureters, transmissions, valves, and brakebands, but no amount of such knowledge can prepare him for the beauty of appearance and performance of the complete vehicle as it rolls smoothly along the highway. Accordingly, we feel that the ecological chapters constitute an essential part of the beginning course, and are heartened in observing the inclusion of such material in more and more of the leading textbooks of biology and zoology. The trend of recent years is in the right direction.

# Student Choices of Outside Readings in Biology

During a three-year period I required the students in my General Biology course to read and report on at least one book per semester in addition to their regular reading and studying for the course. They were permitted a free choice from a rather extensive list, which consisted principally of books on biological subjects written for general public consumption, but included also a few of the more readable textbooks.

The purpose of this assignment was primarily to acquaint the students with the popular literature in the field in the hope that they might continue to do some reading in biology after completing the course. Since most of the students were not biology majors and would never become acquainted with the technical literature of biology, a stimulation of interest in the popular literature seemed to be the most that could be hoped for, even though such literature may not always be as accurate as biologists might wish. Since most of the books deal with such applied fields of biology as medicine, hygiene, agriculture, eugenics and conservation it was hoped that they would also enrich the course by giving the students a better concept of some of the ways in which biology may be utilized for human welfare.

A total of 736 reports was made on

74 different books. It is interesting that 397 or 54 per cent of the reports were made on ten of the books and only 339 or 46 per cent on the remaining 64 books. The list of the ten leading favorites, together with the number of reports made on each follows:

| | | |
|---|---|---|
| 1. | DeKruif—*Microbe Hunters* | 68 |
| 2. | Huntington—*Tomorrow's Children* | 57 |
| 3. | Guttmacher—*Life in the Making* | 49 |
| 4. | Clendening—*The Human Body* | 49 |
| 5. | Menninger—*The Human Mind* | 43 |
| 6. | Diehl—*Healthful Living* | 42 |
| 7. | DeKruif—*Why Keep Them Alive* | 24 |
| 8. | McCullom and Becker—*Food, Nutrition and Health* | 23 |
| 9. | Fishbein—*Shattering Health Superstitions* | 22 |
| 10. | Sears—*Deserts on the March* | 20 |

No attempt is made to explain the preference for these particular books. Recommendations by other students probably played a major role. The length of the books, the ease with which they could be read, and the degree to which the students found them interesting were probably all involved. At any rate, the list represents the free choices of the majority of the students from virtually the entire field of popular biological books.

Victor A. Greulach,
*University of Houston,*
*Houston, Texas*

## A SHOE-BOX HERBARIUM

Much has been written about methods of storing and mounting plant specimens. The use of standard mounting paper in $11.5 \times 16.5$ inch sheets is described in any textbook, and the advantages of such practice are so well known as to need no comment. Likewise, the value of collecting as a means of learning plant identification needs no apology. It is when we try to adapt standard herbarium methods to individual practice that we run into difficulty. First, a collection of a few dozen or even a few hundred species from a given locality rarely has value to anyone other than the person who gathers them. Second, the individual, whether amateur, or science teacher, cannot afford the cost of mounting specimens on standard herbarium sheets, which are hard to store and are highly perishable unless properly stored. A miniature herbarium is an excellent solution of this problem.

One of our graduate students a few years ago made such a collection, with such excellent results that we have recommended it in several cases since.

The specimens are carefully selected to fit on $4 \times 6$ inch cards and after being dried are mounted on such cards with label in upper left hand corner. They are filed vertically in a card file. A shoe box will serve, in case a more substantial file is not available. Teachers may find it desirable to cover specimens with cellophane. For personal collections it is doubtful if this is justified. If cellophane is used it should not be stretched too tightly, or shrinking will bend the card. Additional data may go on the back of the mount. A few crystals of *para-dichloro-benzene* should be added now and then to keep out insects.

A miniature collection requires more discrimination in choosing specimens than a standard-sized one. If it is used as a beginning, it develops a sense of value in all things pertaining to plant classsification and may either be kept as a reference for several years or if the collector becomes professional, may be discarded in favor of the standard herbarium.

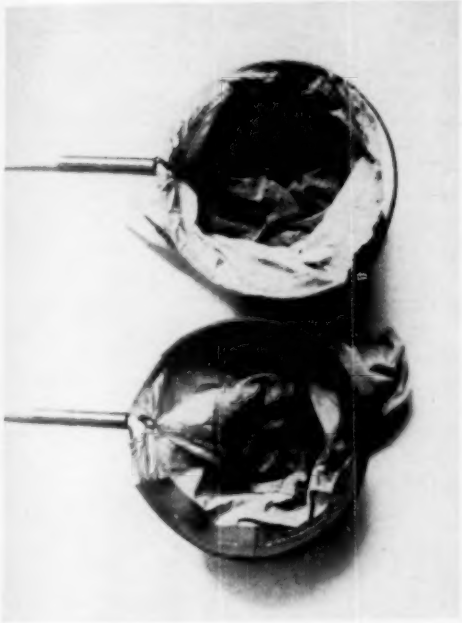
W. A. Anderson,
*Department of Botany,*
*State University of Iowa,*
*Iowa City, Iowa*

Field Trips Issue II, under the guest editorship of Lee R. Yothers, Rahway, New Jersey, has been scheduled for *February;* Visual Aids Issue II, with Addison Lee, of Austin High School, Austin, Texas, tentatively for *April.*

## LONGER LIFE FOR A DIP NET

The cloth of dip nets soon wears over the metal rim. In fact, we rarely get more than one month's use from a new net before it needs repair. We have found that a strip of old inner tubing stretched over the rim prolongs the life of the net for at least two years. The accompanying "before and after" picture shows how the tubing is attached to the rim.

BROTHER H. CHARLES, F.S.C.,
*Saint Mary's College,*
*Winona, Minnesota*



## PRESSING AND MOUNTING PLANTS

September 11, 1945

Dear Dr. Breukelman:

The interesting article in the May number by Egbert H. Walker on methods of plant collecting leads me to offer a couple of simple suggestions in regard to pressing and to mounting.

On short field trips I carry a portable press of standard 12 × 18-inch size made of light wooden slats and held together with two or three elastic bands cut from the inner tube of a balloon tire. The advantages of the constant pressure on the specimens are obvious enough. Such a press can carry two dozen or more plants without becoming too bulky or heavy. The cardboard from grocery store cartons has one advantage that Mr. Walker did not mention in that it admits air to interior of the press, hence it is a good plan to insert a sheet of it now and then between the sheets of blotter or newspaper in which the plants are pressed. If such a sheet is used next the outside a piece of plywood will make fully as good a press as the supply houses furnish.

For mounting I use a cellulose acetate cement instead of the usual strips of paper. It has the advantage of being strong, waterproof and permanent besides being applied to the under side of the specimen where it does not show. If it comes loose here and there it is always possible to renew it later on. The plant must be dry before cementing it down and a weight is needed to hold it in place until the cement dries.

Hoping that these suggestions may be of use to some of your readers, I am

Sincerely,

PHILIP H. POPE,
*Whitman College,*
*Walla Walla, Washington*

## RANDOM NOTES

Affiliation with THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE has been accomplished. Our association is entitled to two representatives on the AAAS council. Former President and Secretary-Treasurer George Jeffers and former Editor-in-Chief E. C. Colin have been elected.

THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS passed a resolution favoring the passage of the Magnuson Bill and H.R. 3852, providing for 6000 four-year undergraduate and 300 graduate fellowships in mathematical, physical and biological sciences, and establishing a *National Scientific Research Foundation.*

A bill to give Federal Aid to promote the extension and improvement of courses of instruction in natural science through public secondary schools has been presented.

General Biological Supply House is addressing and mailing 17,000 membership-invitation cards; we hope this will help materially in helping us to reach our membership goal—3000 members.

Read *Notes on Chicago Meeting* for the latest developments of the Association and the Journal.

# Notes on Chicago Meeting

Twenty-eight officers, associate editors, and committee chairmen, coming from Illinois, Indiana, Kansas, Michigan, Minnesota, New York and Wisconsin, attended the meeting of the Representative Assembly in Chicago, October 13. The morning and afternoon sessions were taken up by reports and business matters; the evening was devoted to a banquet meeting, attended also by members of the Chicago Biology Round Table. At this meeting, Dr. Carroll Birch, of the School of Medicine of the University of Illinois, discussed in her usual charming manner some of the effects of the war in relation to the incidence and possible spread of various tropical diseases and parasites.

Following is a condensed report of the meeting:

Meeting called to order by President Prevo L. Whitaker

REPORTS:

M. A. Russell, Secretary-Treasurer
O. D. Roberts, Managing Editor
H. P. K. Agersborg, Membership Committee
E. Laurence Palmer, Conservation
John Breukelman, Editor-in-Chief
Prevo L. Whitaker, Committee on Local Associations

All reports adopted on motion.

MOTIONS:

1. That the series of *Conservation Units* be continued, with no specific number per volume to be specified.

2. That a committee be appointed to investigate the possibility or feasibility of Association activity in the field of teacher placement.

3. That a committee be appointed to study the possibility of a summer camp for teachers and advanced students, sponsored by THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS. (A later motion delegated the duties of this investigation to the Conservation Committee.)

4. That, beginning at a technically suitable time, one page of each issue of the journal be devoted to a "nature calendar" for the following month.

5. That the fiscal year of the ASSOCIATION and the *Journal* be changed from July 1–June 30 to January 1–December 31.

6. That THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS go on record as favoring the enactment of Bill S 1316, which would provide Federal Aid to promote the extension and improvement of Natural Science courses in the public secondary schools.

7. That President Whitaker be empowered to represent THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS in matters pertaining to mutual cooperation with THE NATIONAL SCIENCE TEACHERS ASSOCIATION.

8. That the Secretary-Treasurer act as director of leadership in matters dealing with school legislation.

9. That a representative be appointed to meet with the officials of the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE in Chicago, October 21. (President Whitaker appointed Miss Helen Trowbridge.)

10. That a committee be appointed to investigate and work out recommendations regarding cooperation with *Friends of the Land* and *The National Conference for Cooperation in Health Education.*

BUDGET:

A tentative budget was adopted. The total amount budgeted was $4865, of which the major item was $3330 for *The American Biology Teacher* printing and a total of approximately $400 for other expenses pertaining to the operation of the journal. Details of the budget will appear in later issues.

ELECTION:

In accordance with the constitution, a nominating committee was appointed. It is hoped that the report of this committee will be ready for printing in the February issue.

The spirit of the entire meeting was one of optimism and enthusiasm. The general feeling was that as an association we can do much to better biology teaching at various levels, both by aiding existing plans and by developing new ones. We must continue to improve teaching aids and materials, to examine our teaching approaches, and to integrate biology with its related fields, such as conservation, health education, and nature study.

# Diseases and Infestations in Captive Snakes

ABBOTT BOOK
Community High School, Lebanon, Illinois

Perhaps the greatest problems confronting snake collectors and exhibitors have been diseases and infestations found in captive specimens. Experimental studies by pathologists have been based somewhat on the relationship between the diseases and infestations found in reptiles and their counterparts known to exist in birds and mammals. The results of pathological examinations might be considered of two-fold value; namely they have provided rather precise information on the subjects with suggestions for prevention and cure, and in addition, have aided in the eventual extermination of certain diseases in man and other animals. Reptilian pathology is still a relatively unexplored field. However, the available information on the subject is undoubtedly of the utmost value even now.

## Mouth Rot

Among the foremost destructive diseases in captive snakes is found a bacterial infection known as *mouth rot*. This disease is purely local in the gums, occasionally developing into deep-rooted inflammation of the jaw-bone and oral cavity, and in most cases terminating in general decomposition. There are two known forms of the disease: The mucous form causing death within a few days, and a chronic form which may last several months until the snake either dies or recovers. The disease appears as a small pinkish white patch in form, and found in the mouth. Examination under the microscope has shown the patch to be made up of necrotic or dead cells. The patch enlarges until complete obstruction of the mouth cavity kills the animal. The fundamental cause of the disease has not been discovered. It is possible to determine the presence of the infection in its early stage and remedy it by frequent and regular treatments of antiseptic solutions. Removal of eroded tissues and cheesy matter from the teeth by means of forceps and application of any of the following preparations have been the principal methods of treatment. A *three per cent solution* of iodine, *full strength solution* of hydrogen peroxide, *ten per cent solution* of boracic acid, *twenty per cent solution* of potassium permanganate, *ten per cent solution* of chlorozene or other commercially sold antiseptic solutions are recommended by leading pathologists and zoologists. Treatment with powdered urea, applied to the necrotic tissues, has been used successfully by the New York Bronx Zoo. Also, exposure of infected regions to ultraviolet rays as well as treatment with vitamins, has been tried. Results were good in some cases, but inconclusive since the methods were used simultaneously. Zoologists seem to agree that artificial means (warm baths), by which the sloughing of old skin is furthered, have a beneficial effect on the diseased snakes and in rare instances have led to eventual cure. Frequently, quarters become seeded with the infection, and all snakes kept in the same area become infected. Strict sanitation is essential. It is unknown whether

snakes in their natural habitat are subject to or die from mouth-rot. To determine this would necessitate a thorough clinical and bacteriological examination of snakes as they are found. It is believed, however, that captivity promotes the development of the infection. It is highly improbable that we can ever give captive specimens all the essentials which they can secure in their natural environment. We do not know just what conditions in captivity render specimens susceptible to this disease or to many others.

From zoological records it is found that not all varieties of snakes are equally susceptible to this disease. Pythons and boas are more easily infected than snakes of other orders. Snakes living in water appear less apt to become infected than poisonous snakes.

Reptile caretakers and amateurs are not entirely without danger from infected specimens during handling. The bite from snakes suffering from mouth rot (though not venomous snakes) can produce serious wounds requiring considerable time to cure.

### Tuberculosis

Tuberculosis is known to be prevalent in snakes. Pathological description indicates that the principal gross lesions are large accumulations of white, cheesy material distributed widely throughout the body. In specimens under examination this material was found beneath the skin, in the mouth soft tissues of the neck, lungs, and many other places. The isolated organisms are short, slightly curved, and acid-fast forms of bacteria similar to *Bacillus tuberculosis*. There is no known cure for infected specimens.

### Pneumonia

Diagnosis of pneumonia in snakes is impossible before death; therefore, treatment cannot be given. Refusal of food and sluggishness are noted in the earlier stages. Consolidation of the lung tissue, similar to mammalian pneumonia, has been shown by autopsies made on infected snakes. It is generally believed that spontaneous recovery occurs as frequently as it does among warm-blooded animals. Maintenance of adequately heated quarters with proper ventilation is the only preventative measure.

### Bone Diseases

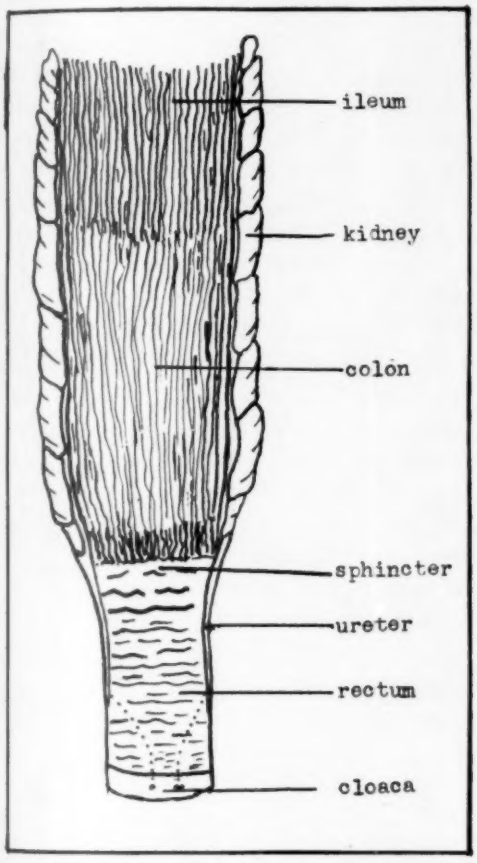
One of the more prominent bone diseases is *osteomyelitis*. The infected bone tissues of the snake are destroyed, with an accompanying discharge of pus. It is generally believed, therefore, that the infection originates about the roots of the teeth, following slight injury, and spreads into the rest of the jaw bone structure. The decomposition of the bone is frequently found to occur, and pieces found free in the pus formation should be probed for and removed. Mild antiseptic solutions are suggested for regular and frequent use. The infection may remain active for a considerable time, even months, but continual attention and care can save most specimens. Records have shown that in some cases the removal of three-quarters of the lower jaw on snakes was effected before final cure was completed.

There were considerable numbers of miscellaneous infections which are known to occur frequently—local abscesses and ulcers, for example. Generally applied medical principles, however, will usually effect cure.

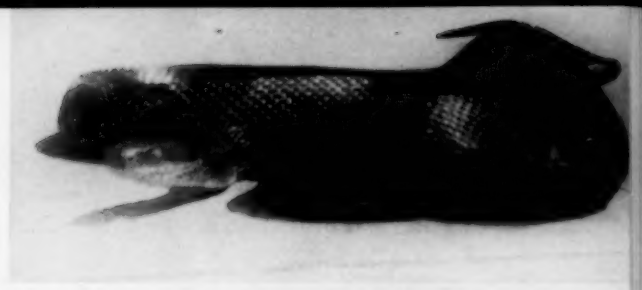
### Amebiasis

Among the various parasitic forms which infest and destroy many snakes is the ameba *Endamoeba invadens*. The Philadelphia Zoological Gardens first recognized this form in 1922 when it was

discovered as the cause of the monitor lizard's *Varanus varius* death. [Previous to that date few specimens were examined post mortem.] From all indications this ameba is considered as a new species, attacking reptiles. A number of experiments carried on by the Philadelphia Zoo have been informative through results obtained. *E. invadens* is known to attack the alimentary tract of reptiles causing death. In snakes known to have developed spontaneous amebiasis, the usual symptoms of the disease did not appear. Many of the specimens failed to feed for a period preceding death, however, it may be pointed out that many snakes do not feed for several months and yet survive. Under other conditions a lack of nutrition has caused death. Therefore, it is difficult to determine whether death is due to the disease or the state of nutrition. In the cases of experimental infections the period from inoculation to death ranges from thirteen to seventy-seven days. During the period, cysts and trophozoites of the ameba form in the colon and rectum. If these are passed with the feces (in the early stages), they are fully capable of maturation and become a potential source of infection. Therefore, a naturally infected snake introduced into a group confined in a small space might easily serve as the origin for an outbreak of amebiasis.




Diagrammatic sketch of the lower bowel of a colubrid. The ileum and colon are continuous although the histologic make-up is distinct. The colon and rectum are separated by a well-developed sphincter, as are the rectum and cloaca. Lesions in the colon usually developed first in the region just above the sphincter. (Redrawn from *Spontaneous and Experimental Amebic Infection In Reptiles*, by Ratcliffe and Geiman.)



Healthy specimen of ***Elaphe obsoleta,*** the Pilot Blacksnake.

In over two hundred controls (freshly collected watersnakes) in the course of experimental work by the Philadelphia Zoo, there were no cases of natural infection by *E. invadens.* Furthermore, the species of ameba have not been found to exist in the alimentary canals of frogs which are the main food of watersnakes. Thus, it is difficult to provide any information on the presence of *E. invadens* in the newly captured watersnakes.

In the majority of cases of amebiasis in reptiles it is a disease of the colon and liver, with lesions developing in the stomach and intestine. Infection is frequently confined to the stomach tissue

or small intestinal tissue. In the regions of the alimentary tract infested by the amebiasis, tissue is gradually decomposed and the surrounding area becomes inflamed.

### Preventative Measures

Should infection occur among snakes in a collection, one of the few sure methods of destroying the infestation is by removing all known infected snakes and by careful cleansing of all cages and implements with which cages are cleaned. Wet brushes used in several cages for cleaning can transport the mature cysts to other cages and infect otherwise healthy reptiles.

### Mites and Ticks

Other prominent sources of infestations include mites and ticks. In case of mites it is suggested that the snakes be soaked in lukewarm water for a period of twenty-four hours or more, during which time the mites will drown. Following the bath, the snakes are dried and a small amount of olive oil is rubbed on their eyes and chins to trap any mites which might have taken refuge there. Disinfecting the cages and using very hot water may eradicate mites and their eggs (mite eggs are non-adhesive), but painting the quarters is the only sure way of getting rid of them. Ticks, which are found most often on tropical snakes, may be removed with forceps or killed by use of *five per cent* powdered rotenone (derris root) in any medium such as calcium carbonate or common talcum powder, applied daily.

The greatest difficulty with snake infestations and disease is that which applies to all kinds of captive animals—the troubles are not detected until they are so far advanced that there is nothing which can be done about them.

Careful selection of proper food is an important factor in maintenance of healthful reptiles. Diseases and parasites which attack birds and mammals will not affect reptiles to an appreciable extent. Therefore, it is possible to use sickly mice or other food animals whose conditions are not up to par for feeding occasionally. Under no circumstances, however, should sickly reptiles be fed to healthy ones for parasites and infection of many kinds are easily transferred from one specimen to another. This would apply in particular to such reptiles as: king snakes and indigo snakes.

Perhaps the best advice to anyone keeping a collection of snakes is to keep the quarters as immaculate as possible, disturb the specimens as little as possible, and take the time and patience necessary to provide food which will be acceptable. Snakes which feed well and which receive a varied diet seldom succumb to disease.

### References

Glidden H. Spencer, Diseases of Reptiles, *Florida Reptile Institute publication,* Silver-Springs, Florida, August 1936.

Burtscher, J., Mouth-Rot in Snakes, *Bulletin of the Antivenin Institute of America,* Vol. V, No. 3, 59–65 pp. May 1932, Philadelphia, Pa.

Ratcliffe, H. L. & Geiman, *Spontaneous and Experimental Amebic Infection in Reptiles,* Archives of Pathology, Vol. 25, 160–184 pp. Feb. 1938.

If you have not already renewed your membership be sure to do so at once. We cannot continue to send the journal to anyone whose name is not on our paid up list. The *November* issue will be the last one you will receive unless you have renewed your membership by *November 24.*

M. A. Russell
*Secretary-Treasurer*

# A Group Plan in Biology

SISTER MARIA, I.H.M.
Immaculata High School, Detroit, Michigan

The chronic expression, "It can't be done" provided a stimulating challenge. What did the field of biology lack that would prevent the use of group work? Why could the subject be taught only in the age-old traditional question and answer method? Why could not the teacher serve as a guide rather than a demagogue—a guide who pleasantly points out paths and fields of new interests to that curiosity-filled adolescent?

Probing along like avenues of thought produced such an impetus that there was nothing left but experiment with the idea. Although it is still in the process of evolving, I offer my plan as a challenge to others who have used group work in order that collectively we might find something that will not only interest the student during the actual periods of biology but also stimulate her through acquired curiosity to broader fields of endeavor.

As the idea was formulating itself into actuality, the classes were about to begin a study of insects. Here the foundation for the new plan was laid. However, to envelop the two-fold purpose as listed above, not only group work but an individual interest scheme was launched. Group work was scheduled for laboratory days wherein neither dissections nor film strips were used during the lecture. On the other hand, individual interest problems, to satisfy the intellectual curiosity of the ambitious student, were offered when visual aids or dissections were the nucleus around which lectures were formulated. This plan will be discussed later.

The biology classes meet as follows: laboratory meetings two days a week, eighty minutes each; discussion classes three days a week, forty minutes each. Whatever new material is to be taught is presented on these so-called "laboratory days" in the form of a lecture. The division of time for a laboratory period wherein group work is scheduled is:

| | | |
|---|---|---|
| 1–2 | minutes. | *Class Assignment* |
| 25–30 | minutes. | *Teaching of New Material* |
| 15 | minutes. | *Workbook Activity* |
| | | Last three minutes of the above, leaders of the respective groups arrange the necessary equipment for their group work. |
| 10–15 | minutes. | *Individual Group Activity* |
| 15– | minutes. | *Open Forum Discussion of the Group Activities* |

The biology sections, four in number, average thirty-six students, thus dividing well into four groups. Each group leader is given her assignment card (3 × 5) the day preceding that section's laboratory period, in order that she might acquaint herself somewhat with the material assigned, and facilitate the procuring of equipment in the "three-minute" above-specified time. The first laboratory period on insects was used to teach the fundamental structure of insects, followed by a dissection of the grasshopper. The next lecture, *Getting Acquainted with Moths, Butterflies and Social Insects,* had group work scheduled as follows:

GROUP 1

On the Seoscope[1] examine the following:

[1] A microprojector capable of projecting living or still life, on a screen or directly on the white base of the machine.

Figure 1. Groups in action in the 10 to 15 minute group activity period. In the background:

Left: Group 2, using slide projector. Right: Group 1, using the Seoscope.

In the foreground:

Left: Group 3, examining various types of insects for different kinds of body parts. Right: Group 4, studying the scales on the wings of a butterfly.

1. Hind leg of fly—What adaptation, if any to function?
2. Insect spiracle—Function?
3. Insect trachea—Function?
4. Scales of moth—How are they arranged?
5. Wing of fly—Notice venation.
6. Wing of bee—Compare with fly for venation. What is the purpose of veins in wings?
7. Mosquito pupa—What stage in insect's life? In what type of metamorphosis?

GROUP 2

Examine the following on the projector:[2]

1. *Grasshopper*
2. *Dragonfly*
3. *Honeybee*
4. *Potato Beetle*
5. *Tomato Worm*

   Locate the three body regions. Are the wings of all alike in structure and appearance?
6. Insect Antennae
7. Insect Eye

   Are these structures alike in all insects?

GROUP 3

Examine with a hand lens:

1. House fly, beetles of various kinds, honeybee, wasp, bumblebee, butterfly, moth.

   Do all have same number of legs, wings, antennae and same number and kind of eyes as the grasshopper?

GROUP 4

1. Put a wing of a butterfly under low power microscope, observing scales. How are they arranged?
2. Carefully scrape scales from the wing. Observe the wing with a hand lens. What happened to the color of the wing when the scales were removed?

According to this plan there is no rotation of group activities. Groups learn about each other's activities in the open forum discussions. At first glance this may seem undesirable, but actual experience proves that greater interest is aroused, and incidentally more knowledge is acquired, since a student is frequently challenged to demonstrate her conclusions and observations if same are not understood by the other class members. The student in question, either with or without the aid of her group, by a blackboard drawing, screen projection of her slide, or a simple explanation (depending on the point challenged) rapidly clarifies her classmates' doubts. Lastly, in putting this matter to a vote before the class—"should we or should we not rotate the group activities"—the answer was a unanimous "no." The reason for the most part was, "it's more interesting and varied to present a discussion of a problem heretofore unexplored by any other group."

If film strips or dissections are used to further correlate the lecture, the same laboratory period time schedule approximately is used as for group work, with the last twentyfive or thirty minutes of the period, however, devoted to individual interest work. Higher ranking sections of the class are the only ones eligible for these activities. These pupils must work independently of con-

[2] A projector for 2 × 2 Kodachromes or plain black-and-white slides.

stant direction from the teacher, allowing the latter an opportunity to give more attention to the average "day-to-day" student. Yet, the teacher can generally oversee this work since all activities are carried on in the one room reserved for biology.

A box with $3 \times 5$ cards, suggesting optional activities, is kept in the room. Various types of interest problems are listed and indexed for each unit of the text book, under the following divisions:

**Dissection**
**Jam Handy Films**
**Microscope**
**Microprojector**
**Seoscope**
**Reference materials**
**Books, pamphlets, workbooks, tests**

A sample card chosen from one of the most popular of the above listed divisions— **Microscope**—reads as follows:

Prepare a slide of pond water.[3] Viewing under low power objective, how many one-celled animals did you observe? Study their peculiar characteristics and their actions as compared with a Paramecium. Are their methods of locomotion the same?

(Check your text book pgs. 40–44 for pictures of various types of protozoans.)

Continue the study at your next available individual interest day.

A student participating in optional activities selects the one that is of vital interest to her. Throughout the year, therefore, she may continue her "researches" in the field that has the greatest appeal; consequently a student may continue a study of protozoan life or microscopic cell structure or purely a testing program, with every available individual interest day. The fields of highest interest appeal have been, Microscope, Seoscope, Microprojector, Dissection, Workbooks and Tests, ranking in the order named.

[3] Bottles of pond water and other culture media are kept in the workroom adjoining the biology room proper. In the fall of the year the students are made acquainted with all available material stored in this room.

Figure 2. Close-up of a group using the Seoscope.

This plan though, as has been stated before, in its embryonic stages has already aptly demonstrated the rise in pupil interest in biology. The group work seems to fulfill the demands of the average student, yet ever stimulating her to paths of greater achievement that like her fellow classmates she too may have the joy of experimenting to her heart's content with the particular phase of biology that is of vital interest to her.

## A SCIENCE TEACHERS' MONTHLY ROUND TABLE PLAN

Progressive teachers throughout the nation are continually on the alert to better their individual and group abilities. Science tea. hers are keen to demonstrate that they possess a teaching field of human interest second to none.

Our science group at North Hollywood Junior High School is made up of seven teachers, one of whom serves as chairman of the group. Each has had college training in a definite scientific field, though in his teaching, he is charged with the task of cutting across scientific

fields in order to present an over-all general science course to beginning students. Such a procedure makes enormous demands upon science information of a widespread nature. Because of their need of much up-to-date information in many science fields, the group actively took part in developing their "Round Table" plan.

### Science Teachers' Round Table

It was agreed upon by the group, acting as a planning committee, that speakers within given science fields be invited to join the group for luncheon meetings one each month.

Because of time pressure, the luncheon seemed to be the most pleasing time in which to meet. No special after-school meeting involving a group bowed down with the day's accumulated fatigue was therefore necessary. It was pleasant to "break bread" in an informal quiet atmosphere. The limit of time required that all members come promptly, that the meeting place be in readiness, that the luncheon details be cared for, and that the speaker be ready to hold forth immediately.

The librarian readily allowed the group to use the library for these monthly meetings, closing it to all others on the meeting day at noon. She was cordially accepted as a member of the group because of her book interest in the scientific field. It kept her in touch with the group's interests and needs for printed items.

The department chairman took over supervision of the luncheon details, sending selected science student helpers to each member with the day's menu for their order. Later these orders were found waiting on the conference table, having been brought from the school cafeteria.

The day's speaker was met an hour before the meeting by a delegated member of the group and taken to the Teachers' Lunch Room for his lunch before the Round Table conference began. In this way, the speaker was in good rapport in meeting with the group. Certainly the food before him, as he talked, could not hold the same interest as it might have done, had he not already eaten.

### Program Topics

In presenting several of the program topics, the reader will see the general trend of planning along this phase.

*Tropical Diseases* was presented to the group by our principal. He had recently returned from a community meeting in which world tropical diseases and the place insects play in their transmission was dramatically presented. Not only did he recapture and translate the enthusiasm of the community speaker but he related the world-wide problem to our immediate environmental needs. One of the large army hospitals is located nearby, and many Pacific War Veterans having island diseases are housed in it. A sluggish river runs the year round through the community and passes this hospital. Recently malaria-bearing mosquitos have been located in its waters. The controls being exercised by the local health department came in for discussion. The double page of tropical diseases appearing in *Life Magazine* was given to each member at the close of the conference.

*The Life Zone Concept in the Study of Biology* was presented by a member of the Los Angeles County Museum staff. This talk was illustrated by the author's outstanding Kodachromes. The group travelled from the sea to the high mountains within the lunch hour and were filled with a strong desire to be in the field rather than returning to classrooms. Again local applications were made in relation to the larger topic of Life Zones.

Another meeting was devoted to methods of self-growth in the realm of field ornithology. Suggested ways and means were presented with the inspiring urge for all science teachers to have many field experiences—the factor that makes the work of the science teacher sparkle with reality! This talk was illustrated with Kodachromes taken by one of the group members whose outstanding ability along this line argues for future departmental plans for local visual aids.

### Some Outcomes

The meetings have offered inspiration and vision. The classroom routine takes on new meaning when viewed from wider scientific angles. No member returned to his class satisfied just to get by on routine teaching.

In rubbing shoulders with other kindred spirits, he found a new sense of security in his work. He realized that he no longer travelled alone in some narrow sphere but rather that he was one of a larger army of inspired teachers in a field unique and satisfying.

The informality of arrangement and the give-and-take between individuals quickly made each one look forward to the monthly event. The group were no longer just professional acquaintances—they were friends teaching within the same field. New strength and helps were found and readily shared instead of being withheld because of uncertainty of reception by other members.

We look forward to the renewal of our Round Table meetings and already plans are afoot for their supplementation by field trips. Science teaching is challenging—its scope is wide and there is so much to experience. Our group feels we have found one way that aids in keeping us "alerted" to our challenge.

L. E. Hoffman,
*North Hollywood Junior High School,*
*North Hollywood, California*

## TREASURER'S REPORT

As of July 1, 1945

**Receipts**

| | |
|---|---|
| Balance, July 1, 1944 | $ 716.10 |
| Advertising | 1126.03 |
| Contributions | 40.15 |
| Old accounts paid | 1.50 |
| Calendar | 161.91 |
| Union of American Biological Societies | 63.79 |
| Check signed | 1.50 |
| Dues paid by members, 1944–45 | 1937.00 |
| " " " " , 1945–46 | 1196.50 |
| " " " " , 1946–47 | 15.00 |
| " " " " , 1947–48 | 5.00 |
| " " " " , 1948–49 | 3.50 |
| " " " " , 1949–50 | 3.50 |
| Binders and back numbers | 76.11 |
| Total | $5347.59 |

**Expenses**

| | |
|---|---|
| Officers' expenses | $ 493.46 |
| Discounts, money orders and checks | 3.50 |
| American Biology Teacher | 3444.61 |
| Printing | 179.08 |
| Membership committee expenses | 291.85 |
| Volumes for Library of Congress | 6.25 |
| Bank charges | 12.22 |
| Unsigned checks received | 1.50 |
| Outdated money order | 1.50 |
| Stenographic service at Cleveland | 27.65 |
| Calendar | 242.39 |
| Balance, July 1, 1945 | 643.55 |
| Total | $5347.59 |

From July 1 to October 1, 1945

**Receipts**

| | |
|---|---|
| Balance, July 1, 1945 | $ 643.55 |
| Back numbers | 36.48 |
| Refund from advertiser | 13.50 |
| Advertising | 304.98 |
| Calendars sold | 33.70 |
| Memberships, 1945–46 | 713.25 |
| " , 1946–47 | 29.00 |
| " , 1947–48 | 4.00 |
| Total | $1778.46 |

**Expenses**

| | |
|---|---|
| Union of American Biological Societies | 10.00 |
| Calendar account | 290.00 |
| Membership committee | 270.59 |
| Officers' expenses | 51.89 |
| American Biology Teacher | 398.19 |
| Printing | 87.22 |
| Bank charges | 1.11 |
| Balance, October 1, 1945 | 669.46 |
| Total | $1778.46 |

# Books

URBAN, JOHN. *Behavior Changes Resulting from a Study of Communicable Diseases.* 1st ed. Bureau of Publications, Teachers College, Columbia University, New York. 110 pp. 1943. $1.85.

Will a study of the more common communicable diseases cause Jim to stop biting his finger nails or make Mary use a handkerchief when she coughs or sneezes? The author of the study made a list of pupil behavior traits which he and a group of critics considered to be contributory to the spread of disease. By carefully controlled classroom experimentation he sought to determine the effects of factual knowledge concerning communicable diseases on the actual overt behavior of high school biology students. Changes in behavior were ascertained by interview and direct observation of pupil activity. Two achievement tests of high reliability and correlation were used also.

Biology teachers must be more concerned in the future over the effects of their teaching on improved student health habits. Careful study of this controlled experiment will be helpful toward that end. It is a direct challenge to us to learn how to make our teaching more effective.

W. A. BETTS,
*University Medical School,*
*Galveston, Texas*

NOBLE, RUTH CROSBY. *The Nature of the Beast.* Doubleday Doran, Garden City, New York. viii + 224 pp. Illus. 1945. $2.75.

This semi-popular discussion of animal behavior was written by the widow of the late G. K. Noble, noted biologist of the American Museum of Natural History. She is a competent biologist in her own right and shared in her husband's work. The book contains seventeen chapters on various phases of animal activity, such as instinct, emotions, social development, courtship, parenthood, hormone effects, abnormal behavior and the like. Clear and concise language brings the more difficult subject matter well within the range of interested high school students. The number of technical terms is relatively small, but there has been no attempt to avoid them completely. They are used whenever necessary for clarity and carefully defined as they appear. There are eight pages of clear photographs illustrating many of the fundamentals described in the text. The bibliography includes both general references and technical papers. The index is unusually well organized and arranged although it omits some of the technical terms used in the text. *The Nature of the Beast* should be on the shelves of all high school and college libraries and will no doubt be widely read by those interested in the every-day activities of animals.

JOHN BREUKELMAN

CHANDLER, ASA C. *Introduction to Parasitology.* Seventh Edition. John Wiley and Sons, New York. x + 716 pp. Illus. 1944. $5.00.

The massing of men and their movement to all parts of the world have greatly increased our need for adequate knowledge of the parasites which commonly affect man. Extensive work in the field of parasitology has been so productive that present texts on the subject must be almost completely rewritten to include the latest findings in morphology, life history and relationships, to present the most modern methods of treatment with such drugs as atabrine and penicillin, and to conform with the new viewpoints resulting from this more extensive knowledge. This edition of a much-used text, while presenting the fundamental facts and principles expected in an introduction to parasitology, includes the latest developments on most of the common parasites affecting man and his domestic animals. Consequently the book can serve the biologist as a handy reference in answering the commonly asked questions relative to the parasites native to other countries as well as to those of our own.

BROTHER H. CHARLES, F.S.C.,
*St. Mary's College,*
*Winona, Minn.*

BETTS, WILLIAM A. and LEE, ADDISON. *Biology Work Text.* The Steck Company, Austin, Texas. 158 pp. 1944.

The eleven units included in this work text cover what is offered in most general biology classes. Each unit is subdivided into problems, which are either experiments or exercises. Every unit is preceded by an introduction which gives the student an overview of the work involved in solving the problems covered in the unit. Parallel references from leading biology text books are given with each unit.

The experiments or exercises are presented in the form used by many teachers, such as: materials, procedure, and conclusions. One feature of this work text, which will appeal to many teachers, is the fact that the experiments and exercises can be completed by the student in a regular class period. There is a minimum of drawing to be done by the

student: diagrams which the student is to label after having examined the particular structure under the microscope have been substituted. No special equipment or elaborate technique is required for these experiments and exercises; they can be worked out by students in schools with a limited amount of equipment and funds for expendable materials. Much of the material needed can be secured locally, and this should be an aid to teachers in schools with limited resources.

At the conclusion of each unit there is a series of review questions, and "Some Things to Do." The suggestions for additional work on each unit are practical and will appeal to the high school boy and girl interested in biology. Self-testing exercises are also a part of some of the units. A separate series of unit tests accompanies the work text. All in all, there is variety enough to take care of the varied interests of biology students.

MELVIN A. HINTZ,
*South Milwaukee High School,*
*Milwaukee, Wisconsin*

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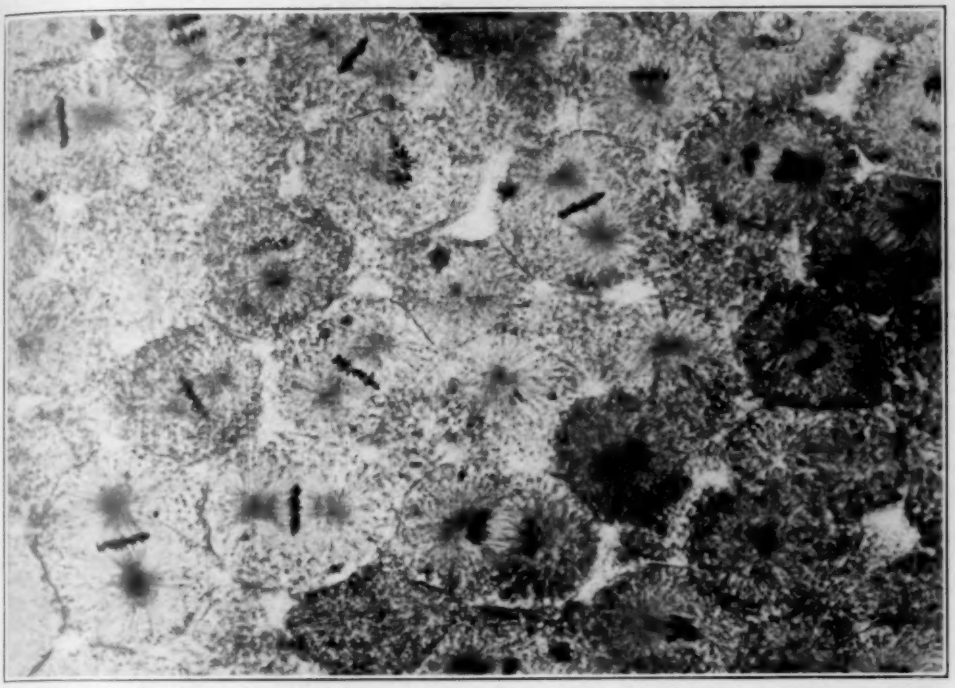

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